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HOW COWS TOLERATE CLIMATE Page 12

AGRICULTURAL
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The Payoff

Research is worldwide. There are no national boundaries to its application.

Research takes time. Those who expect immediate results are usually disappointed. But when a project is finished, the payoff may be handsome.

Nowhere are these facts better illustrated than in agricultural research in foreign countries financed by grants awarded by ARS under Public Law 480.

For example, work by Finnish scientists (pages 3 and 4) has potential benefit for dairymen not only in Finland but throughout the world.

The long-term research was begun in 1959. The payoff—the discovery that dairy cows fed a synthetic diet completely lacking in protein make good gains, produce good-quality milk in high volume, and produce healthy calves. The potential—milk production in countries that cannot now produce protein feeds, and future changes in feeding practices for dairymen everywhere.

Under Public Law 480, U.S. surplus food is sold for foreign currencies. These funds, in turn, are spent locally for many purposes, including research.

Since 1958, ARS has awarded nearly 800 grants in 29 countries. World-renowned scientists head many projects—Finnish biochemist A. I. Virtanen, who directs the protein-free diet project, is a Nobel Prize winner. Research covers such diverse areas as new and expanded uses for farm products; farm crops, soils, and livestock; forestry; economics; and human nutrition.

About 200 projects have been completed. From these, the payoff includes:

- British discovery of substances in oats with wide potential for use as natural food preservatives (AGR. RES., May 1964, p. 5).
- Finnish findings that disprove the theory that milk causes goiter (AGR. RES., June 1964, p. 3).
- Italian development of completely natural fruit-milk concentrates (AGR. RES., January 1965, p. 11).
- British work in rot-proofing cotton by altering cellulose molecules (AGR. RES., February 1965, p. 7).

The payoff from these and many other projects will continue to benefit farmers and consumers everywhere.

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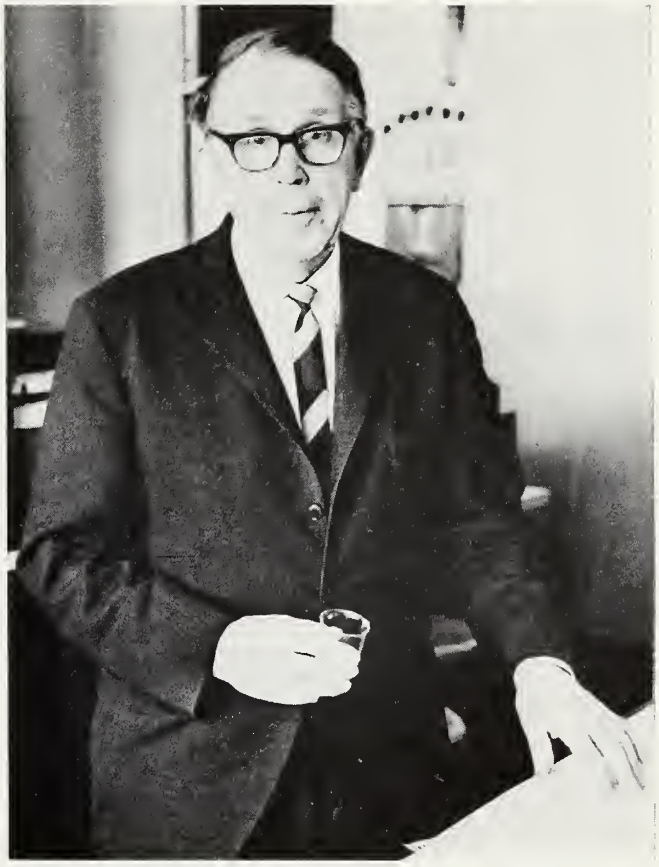

A. I. Virtanen in his Helsinki, Finland, laboratory. (Photo No. PN–1363)

Discovery by Nobel Prize Winner Virtanen . . .

PROTEIN NOT NEEDED IN COW'S DIET

EDITOR'S NOTE: ARS scientists last year determined that a beef cow can gain and reproduce on an entirely synthetic diet (AGR. RES., April 1965, p. 8). That and the discovery reported below have far-reaching potential implications for livestock farmers everywhere, even though they do not change present established feeding recommendations.

Protein is not essential in a milk cow's diet.

This revolutionary discovery, by A. I. Virtanen, Nobel Prize winner and director of the Biochemical Research Institute at Helsinki, Finland, opens the way for milk to be produced even in countries where the high-protein feeds that have been thought necessary for milk-giving cows cannot be grown.

Virtanen started his research, financed by a Public Law 480 grant awarded by ARS, in 1959. Since 1962, he has fed a group of cows an artificial diet of purified carbohydrates; urea and ammonium salts as sources of nitrogen; a mineral mixture containing vitamins A and D, and later also E; and a little corn oil.

Milk from the cows on this diet contains the same nutrients—fat, nonfat solids, sugar, and proteins—as milk from cows on normal feed.

Altogether, six cows were on the test. Their milk yield reaches nearly the average level of Ayrshire cows in Scandinavian countries. Their calves are normal, and meat from the calves is of quality equal to that of cows on normal feeding. The calves themselves have been fed the artificial diet, and have shown good gains.

Virtanen says, "Our studies have shown that the most important flavor compounds of milk are formed in the cow." He is determining to what extent milk flavors come from synthesis within the cow and to what extent they come from feed. "Milk flavors can be classified into two groups: Those transferred from feed to milk by way of the digestive route of the cow and those which are formed in the cow—in the rumen and in the liver or mammary gland—from carbohydrates, amino or fatty acids, and other chemical compounds in the feed," the scientist says.

Previous experiments in the United States and other countries and in his own laboratory had convinced Virtanen that it would be possible to develop in cows, by gradually changing their feed, a rumen microbial population capable, to a greater degree than normal, of using nitrogen from urea and ammonium to synthesize the essential amino acids which are the chief components of protein. He has now proved this to be true. Cows in

his trials had their normal feed gradually taken away from them and the artificial feed gradually added while they were dry or becoming dry.

As the experiment has gone on, Virtanen has increased the daily portion of nitrogen in the feed. As he has done so, milk production has increased to a peak so far of 9,460 pounds from a single cow in a year.

Every day each cow gets 20 pounds of compressed briquets containing purified starch, cellulose, sucrose, and urea and ammonium salts; 8 pounds of a wet paste rich in celllulose; and small amounts of corn oil and commercial preparations of vitamins A, D, and E.

At the beginning of the experiment, the cows were allowed to chew rye or wheat straw to improve rumination. Now cellulose strips impregnated with silicic acid have been substituted. But the cows are still allowed to chew hard rubber tubing to help the secretion of saliva. ■

Milkmaid Liisa Rahikainen (Photo No. PN–1365), weighs and feeds the cows white food briquets. (Photo No. PN–1366)

Virtanen and his laboratory staff form a panel to test the taste and smell of milk from cows on the artificial diet. "It tastes like any other milk, and has no off-flavors," Virtanen says. He explains that gas chromatographic analysis shows some differences in volatile substances between the test milk and normal milk but the differences seem not to have any great influence on the taste and smell of the milk. (Photo No. PN–1364)

The cows are satisfied with their feed and don't seem interested in the green grass surrounding their pen on Virtanen's farm near Helsinki. (Photo No. PN–1367)

Distinguished, superior service

16 Individuals, Groups in ARS Honored for

THREE DISTINGUISHED and 13 Superior Service Awards have been presented to individuals and groups in ARS by Secretary of Agriculture Orville L. Freeman.

The recognition—for high achievement in research and regulatory activities—was given during USDA's 20th annual award ceremony on May 17 in Washington, D.C. Secretary Freeman presented a total of 104 awards to USDA employees.

For distinguished service

Victor R. Boswell, *Crops*, for distinguished leadership and inspirational advancement of American vegetable research which led to many scientific breakthroughs in improving vegetable and ornamental plants. (See "Bacterial Spot in Peppers," AGR. RES., March 1965, p. 14; "Now, Tomatoes Resist Curly Top," AGR. RES., June 1963, p. 12; "New Nematode-Resistant Lima Bean," AGR. RES., April 1958, p. 5.)

Leroy D. Christenson, *Entomology*, for conceiving, planning, and supervising research on areawide methods for eradicating or suppressing insect pests. Christenson provided expert direction for insect population suppression programs using biological methods to control several major fruit and vegetable insect pests. (See "Eradicating the Melon Fly," AGR. RES., August 1963, p. 5; "Oriental Fruit Flies Gone From Guam," AGR. RES., May 1963, p. 12.)

Michael J. Copley, *Western Utilization*, for wise and vigorous leadership of research in the development of new and improved products from farm commodities. Copley directed the development of new wheat products and economical wheat processing methods. (See "Peeled Wheat," AGR. RES., January 1965, p. 15.)

For superior service

Mechanical Cherry Harvesting Group, *Eastern Utilization* and *Agricultural Engineering*, for outstanding service to agriculture through the development of equipment and methods for harvesting red tart cherries mechanically and maintaining cherry quality during harvesting, handling, and processing. (See "A Study in Automation," AGR. RES., August 1965, p. 14.)

Crambe Team, *Northern Utilization* and *Crops*, for interdisciplinary research with excellence of vision, scientific attainment, and teamwork that resulted in the introduction and utilization of crambe as an oilseed crop new to American agriculture. (See "Broadening Horizons for Crambe Oil," AGR. RES., May 1965, p. 6.)

Carbamate Finishing for Cotton Group, *Southern Utilization*, for development of a new class of finishing agents that produce superior wash-wear cotton fabrics either by conventional or permanent-press processes. (See "New Finishing Process for Cotton Wash-Wear," AGR. RES., November 1961, p. 10.)

DS *(Continued)*

M. J. Copley (Photo No. PN–1368)

Harold W. Hawk, *Animal Husbandry*, for individual research leadership yielding new and significant knowledge on the physiological mechanisms involved in animal fertility. (See "How Do Implanted Spirals Stop Animal Reproduction?" AGR. RES., January 1966, p. 4.)

Charles F. Lewis, *Crops*, for conducting comprehensive regional cotton variety testing and for outstanding leadership in a research program which contributed significantly to the development of 9 improved cotton varieties and to new discoveries in genetics. (See "Glandless Cotton," AGR. RES., August 1964, p. 5.)

William F. Rochow, *Crops*, for determining variability among strains, vector specificity, mode of purification, and physical nature of barley yellow dwarf virus. (See "We're Advancing on Yellow Dwarf," AGR. RES., December 1960, p. 10.)

Philip S. Callahan, *Entomology*, for

V. R. Boswell (Photo No. ST–1003–7)

developing a theory and presenting evidence that insects detect and transmit infrared and microwave radiation. (See "Do Moths Use Radar," AGR. RES., February 1966, p. 3.)

Arthur M. Heimpel, *Entomology*, for outstanding studies of the mode of action and safety of insect pathogens, and aggressive leadership in the development of methods for the use of these natural insecticides. (See "How Near Are Virus Insecticides," AGR. RES., August 1965, p. 10.)

Emory D. Burgess, *Plant Pest Control*, for exceptional leadership in directing progressive pest control and eradication programs to protect American agriculture from serious insect pests and diseases introduced from abroad. Burgess also encouraged the development of low-volume application techniques for pesticides. (See "Efficient Aerial Spraying," AGR. RES., March 1965, p. 10.)

Robert E. Hargrove, *Eastern Utilization*, for outstanding contribution to the cheese industry through the discovery of a practical means of preventing serious economic loss due to failure of bacterial starters used in making cheese. (See "Protecting a Cheesemaker's Starter," AGR. RES., July 1959, p. 11.)

L. D. Christenson (Photo No. ST–1035–18)

Felix H. Otey, *Northern Utilization*, for exceptional creativity and diligent research in developing a practical low-cost process for making glycol glycosides directly from starch for use in making rigid urethane foam for industrial insulation. (See "Spray-On Insulation," AGR. RES., January, 1966, p. 8.)

Robert M. Horowitz, *Western Utilization*, for discovering and identifying compounds responsible for bitterness in citrus, determining their chemical structures, and developing procedures that convert these compounds into extremely sweet substances with potential commercial use.

Harold P. Lundgren, *Western Utilization*, for distinguished research leadership that has advanced basic knowledge in organic and physical chemistry, biochemistry, and wool textile technology. Under Lundgren's leadership, the Wool and Mohair Research Laboratory developed Wurlan wool. (See "Wool Meets Modern Needs," AGR. RES., June, 1964, p. 10.)■

ARS Scientist in Africa Developing Test for

BOVINE PLEUROPNEUMONIA

An ARS scientist in Kenya is developing a skin test for animals that have recovered from but are still able to spread contagious bovine pleuropneumonia. Its successful development may lead to similar tests for related diseases of animals, birds, and man.

Completion of the work by ARS microbiologist Moshe Shifrine and research veterinarian R. N. Gourlay of the East African Veterinary Research Organization should also help to improve the livestock industry in Africa and help protect this Nation's cattle from pleuropneumonia.

Shifrine and Gourlay have broken down the agent that causes pleuropneumonia, and have tested the resulting fractions on animals immune to the disease. So far, one fraction shows promise for detecting animals that are carriers of pleuropneumonia.

Pleuropneumonia occurs in parts of Asia, Africa, Australia, and Russia. It seldom results in death but causes considerable loss in milk and meat production.

Imported cattle introduced the disease into Eastern United States about the middle of the 19th century. Its spread led to the establishment of the former Bureau of Animal Industry in USDA in 1884. By 1892, the disease was entirely stamped out in this country, and has not reappeared here since.

The disease affects only cattle. The agent that causes pleuropneumonia, however, is closely related to agents that cause respiratory diseases in birds and animals, and has been blamed for abortions in cattle and arthritis in sheep, hogs, and man.

In their experiments, Shifrine and Gourlay use East African Zebu cattle or crosses of these native cattle with European breeds. To make these animals immune to pleuropneumonia, the scientists inoculate them with *Mycoplasma mycoides*, the causative agent. After at least 2 months, the scientists inject various parts of the disease agent into the skin on the side of each animal's neck. If the skin at the injection site thickens, the animal is a carrier of pleuropneumonia.

One fraction—produced by the extraction of *M. mycoides* with hot phenol and combined with a corn oil additive—has produced this reaction. Shifrine and Gourlay plan further tests with that fraction.

FOR MECHANIZED FRUIT HARVEST . . .

Experimental Conveyor Prevents Bruising

An experimental fruit conveyor designed by ARS agricultural engineer A. G. Berlage transfers tender fruit from pickers' hands to bulk bins without injury. If successfully developed for commercial use, the conveyor could lead to more complete mechanization of fruit harvesting. By preventing bruising, it would also maintain market quality of fruit.

So far, the process of transferring fruit from picker to bulk bin without injury has defied mechanization. Growers have tried conventional conveyors, but they have not worked well. They allow fruit to slide and roll and can't be adjusted to permit fruit to move up, down, or laterally as a picking machine moves across rough terrain.

Berlage's conveyor, built in cooperation with the Washington Agricultural Research Center at Wenatchee, overcame these shortcomings in field tests during the 1965 harvest season. Further tests are planned this year.

The conveyor consists of two belts, each padded with a polyfoam material 2 inches thick. Berlage used it as part of a self-propelled machine that carried two pickers and a bulk bin.

Pickers placed fruit at the upper end of the conveyor as the picking machine moved between two rows of trees across rough terrain. The fruit, held gently between the foam belt facings, did not roll or slide and was conveyed to the bulk bin without damage.

To accommodate fruit of different sizes, polyfoam belts of different thickness were used.■

Painless Method Developed for Marking Livestock, Pets, Wildlife

1

FREEZE BRANDING

A METHOD OF BRANDING animals with intense cold—rather than heat—has been developed by ARS research veterinarian R. K. Farrell at Pullman, Wash.

The method, called "freeze branding," is painless to animals. For the livestock industry, it has the potential of reducing the damage to hides from hot branding, estimated at about $20 million per year.

Freeze branding, if successfully developed for commercial use, could also be used by pet owners to mark their animals to prevent theft; and by wildlife conservationists in life-cycle studies.

Working with scientists at Washington State University, Farrell has freeze-branded a wide variety of domestic, game, pet, and marine animals.

His technique involves applying material in the shape of the desired identification mark, chilled to an extremely low temperature, to the animal's skin. This kills the cells that produce pigment in skin and hair. When the brand thaws, hair falls out. New hair that grows back, in about 2 or 3 weeks, is white since there is no longer any pigment to color it. There is no damage to the animal's hide.

Obviously, a white freeze brand shows up best on an animal with dark hair. A white animal can be freeze-branded, however, by leaving the chilled material on long enough to kill the hair roots. The resulting brand is similar to that made with a hot iron. In this case, the hide is damaged to some extent but much less than with a hot brand.

Since freeze branding is painless, the use of the technique makes animals easier to handle during branding. The white brand is particularly useful for spotting animals from a long distance. For that reason, Farrell reports, wildlife conservationists are interested in the possible use of freeze branding for following migrations from the air in life-cycle studies of such animals as seals, wolves, and caribou.

Farrell has freeze-branded animals by applying chilled metal, solid carbon dioxide (dry ice), and other material to the skin. The material used has little effect on the outcome as long as the skin is frozen correctly. Simplest and most economical, Farrell has found, is the use of a copper brand, chilled in a bath of dry ice and alcohol to −69 degrees F., and applied for 30 seconds. Use of this method, he estimates, would cost about 5 cents per brand.

The technique is still being improved, and isn't ready for commercial use. Farrell considers time and temperature important in freeze branding, since underbranding will result in no permanent mark and overbranding causes permanent loss of hair. He wants to find out whether time and temperature requirements vary with the season of the year and with the age, breed, and species of the animal.■

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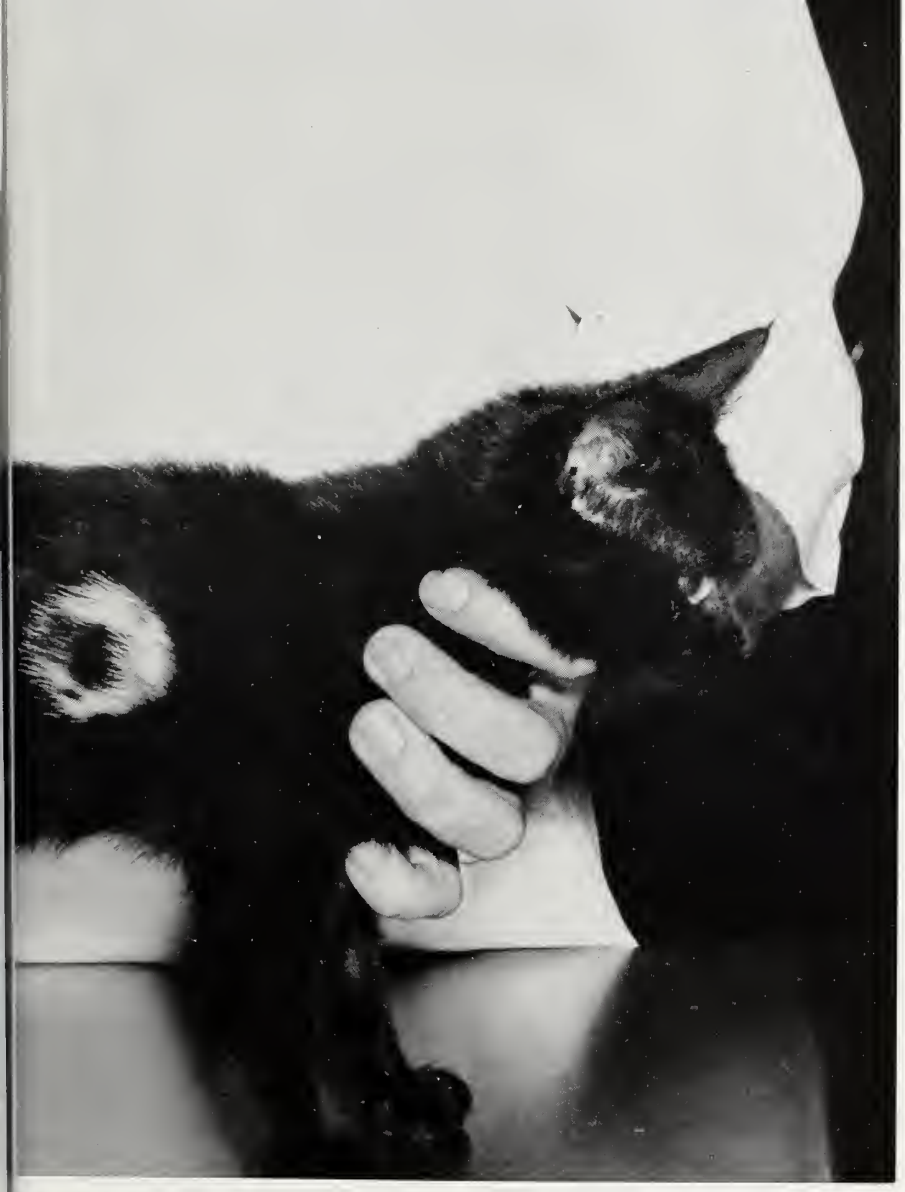

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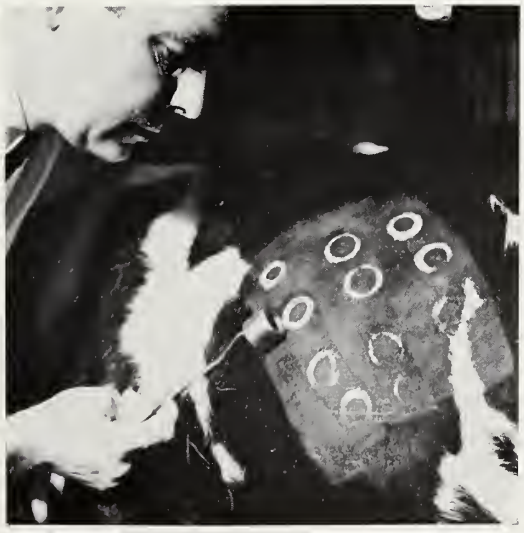

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5

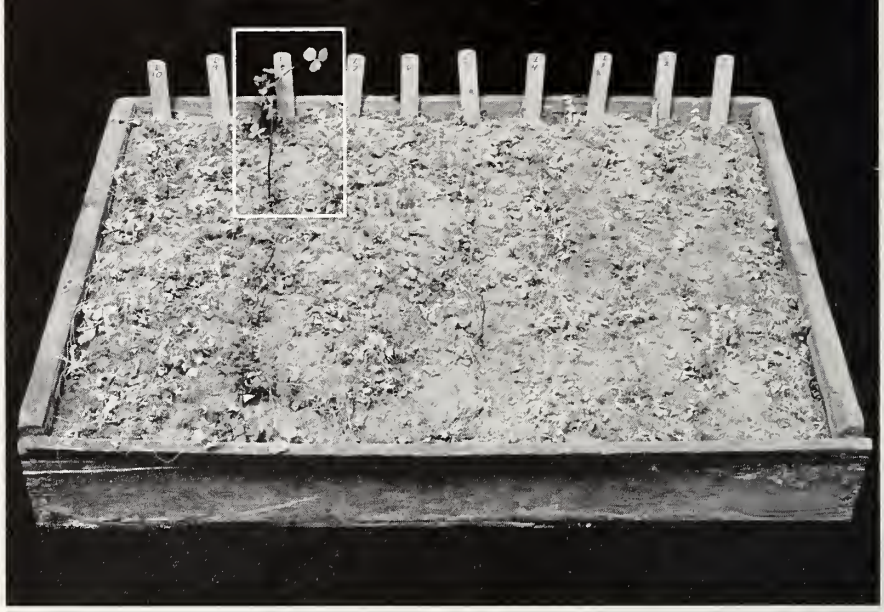
1. For freeze branding, the iron must be chilled to an extremely low temperature. Here, R. K. Farrell, who developed the method, chills a branding iron to —310 degrees F. in liquid nitrogen. (Photo No. PN–1369)

2. Farrell applies the chilled branding iron. Since the method is painless, the cow offers no resistance. (Photo No. PN–1370)

3. Hereford branded with irons of various metals, left on skin for different lengths of time. Farrell points out 40-second brand with copper iron. Hair was clipped before branding. (Photo No. PN–1371)

4. This cat was freeze branded experimentally for 10 seconds with iron chilled in dry ice and alcohol at —94 degrees F. Pet owners using freeze branding for identification might prefer to have their animals marked in inconspicuous locations with smaller branding irons. (Photo No. PN–1372)

5. Sea lion freeze branded for identification. (Photo No. BN–27096)



MASS SEEDLING SELECTION FOR . . .

RESISTANT ALFALFA

SCIENTISTS ARE INFESTING alfalfa seedlings with insects and disease to speed the development of varieties with multiple resistance.

ARS agronomist E. L. Sorenson and agronomist H. L. Hackerott and entomologists R. H. Painter and T. L. Harvey of the Kansas Agricultural Experiment Station used this approach to develop Cody, a variety resistant to spotted alfalfa aphid and grown extensively in the Great Plains.

A recent example of the use of mass greenhouse screening was the development by ARS and the Nevada Agricultural Experiment Station of Washoe, a variety adapted for Western States and highly resistant to pea aphid, spotted alfalfa aphid, stem nematode, and bacterial wilt.

Sorenson, Hackerott, Painter, and Harvey have also developed experimental lines resistant to spotted alfalfa aphid, pea aphid, and bacterial wilt. They are now studying techniques for adding resistance to the potato leafhopper.

In their mass screening, the scientists infest large greenhouse alfalfa populations at the stage of growth when the seedlings are most susceptible to an insect or disease. Susceptible seedlings are killed. The remaining vigorous survivors provide resistant material for further intensive screening, breeding, and testing.

Mass greenhouse screening is especially valuable because resistant plants often exist as a small fraction of a susceptible population. Finding these plants in the field may take years because pest infestations can't be controlled and pest damage is often masked by other conditions. In the greenhouse, under controlled conditions, scientists can evaluate thousands of plants in a short time.

By combining mass greenhouse screening with recurrent selection (breeding to increase favorable genes by repeated selection), the scientists can progessively increase resistance. In the three cycles of screening and selection used to develop one experimental line, percentages of plants resistant to spotted alfalfa aphid increased from 3 to 35 to 77 percent; and to pea aphid, from 9 to 20 to 53 percent.

Screening based on seedling mortality, the scientists point out, measures the sum of resistant mechanisms—preference of the insect or disease, tolerance of the plant, and the ability of the plant to inhibit vigor or growth of the insect or disease.

The technique made possible the development of Cody from its parent variety, Buffalo, in a single cycle of selection. About a quarter million Buffalo plants in greenhouses were heavily infested with aphids at the trifoliateleaf stage of growth, the stage when alfalfa plants are most susceptible to spotted alfalfa aphid damage.

All but 1 percent of the plants were killed within a month. The scientists used the survivors to develop Cody.

Variety trials and successful commercial use demonstrate the value of

In developing Cody alfalfa, scietists infested greenhouse seedlings of Buffalo, the parent variety, with large numbers of spotted alfalfa aphids. In this flat, one resistant plant (outlined) survivied, and was among those used to develop the new variety. (Photo No. PN–1373)

Originally, this flat contained seedlings of Buffalo and Cody alfalfa, in alternate rows. After infestation with spotted alfalfa aphids, the rows of Buffalo were killed off. Those of Cody survived. (Photo No. PN–1374)

Cody. At Mound Valley, Kans., for instance, 17 varieties were seeded in an area heavily infested with aphids. Only Cody and Lahontan, a resistant variety adapted to the Southwest, maintained satisfactory stands.

In screening for pea aphids, the scientists infested seedlings in the cotyledon stage of growth. when alfalfa is most susceptible to this pest. Additional aphids were added to maintain a high population and barriers were used to confine them to the seedlings. Again, a small percentage of resistant alfalfa seedlings survived.

To develop multiple resistance, the scientists infested seedling plants with pea aphids in the cotyledon stage. Surviving plants were infested with spotted alfalfa aphids. Aphid resistant plants were inoculated with bacterial wilt. Plants that survived these tests were then used to develop experimental lines with high levels of resistance to both insects and the disease.■

FAN COLLECTS INSECTS UNHARMED

A net and a good pair of legs are all most collectors need to catch all the insects they want.

But scientists often require large numbers of insects from natural populations, a fact that prompted ARS researchers at Tifton, Ga., to design a collector that harvests mass numbers of insects without seriously harming them.

The developers, agricultural engineers E. A. Harrell and W. W. Hare and entomologist J. R. Young, have used the device to collect corn earworm and fall armyworm moths.

The collector is basically a centrifugal fan, the main part of which is an impeller—a cylinder with vanes. As the cylinder rotates, air is forced through the vanes. Insects are drawn in by suction, bypass the impeller, and are blown into a storage chamber. Common window screen is used to keep the insects from going into the impeller, where they might be injured.

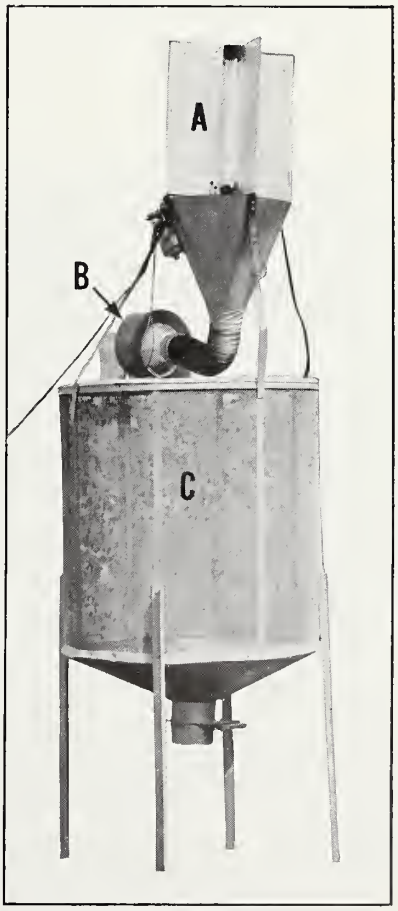
The collector can be combined with an insect light trap. With such a combination, insects are attracted to the vicinity of the collector by fluorescent light, and are drawn into the storage chamber by the action of the impeller.

The device, the developers say, might be modified to segregate captured insects by size.

If chemosterilants are found to be effective and safe, it might be used with a light trap to bring male insects into a chamber where they would be exposed to a chemosterilant.

For these uses, it would be important that captured insects remain unharmed. So far, the researchers have passed the same adult speciments of corn earworms and fall armyworms through the fan four times at velocities of 600 to 900 feet per minute without apparent injury.■

The modified centrifugal fan developed by ARS at Tifton, Ga., (B) is shown with an insect light trap (A) attached. Insects are collected in the large chamber (C). (Photo No. PN–1375)



With Plastic Tent, Scientists Learn How . . .

COWS TOLERATE CLIMATE

ON THE COVER

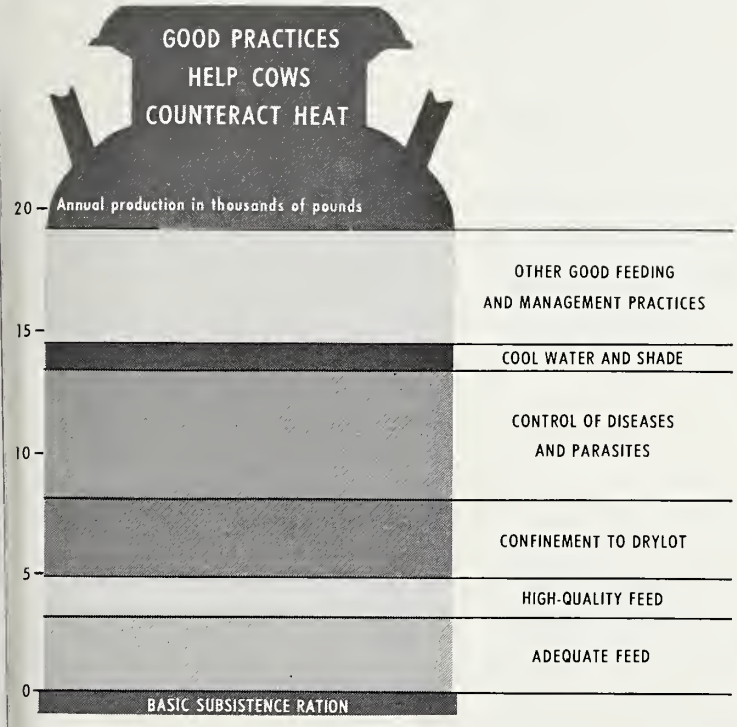
Dairy physiologist A. J. Guidry attaches respirometer which measures breathing to the muzzle of a cow in the polyethylene plastic tent developed by Guidry and R. E. McDowell to measure heat loss through perspiration. (Photo No. ST–1058–18)

A Holstein stands calmly, completely enclosed in 10- by 3- by 5½-foot plastic tent. Guidry monitors console with automatic recording equipment. (Photo No. ST–327–1)

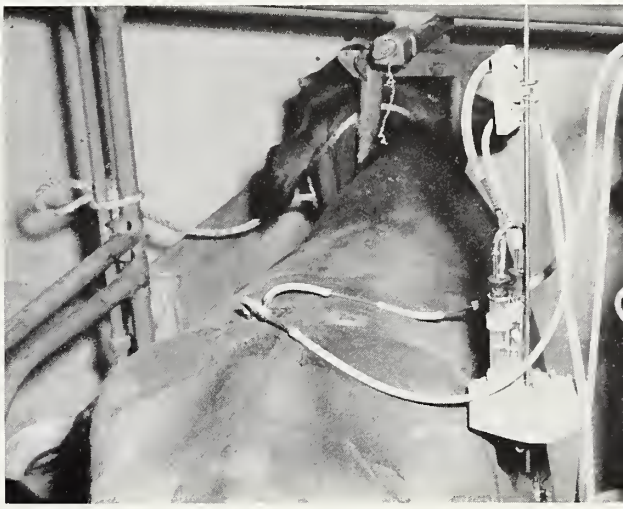
ARS RESEARCHERS at Beltsville, Md., have developed a polyethylene plastic tent to measure the moisture a cow loses through perspiration.

With it, dairy physiologists R. E. McDowell and A. J. Guidry expect to learn precisely how a cow counteracts heat stress. Then, they hope to develop breeding and management techniques to help cows overcome the effects of heat and humidity, thus improving milk production in hot climates.

From previous research, McDowell and Guidry know that as temperature rises above 75 degrees F. and humidity goes above 60 percent, milk production drops. A prize cow with a potential of 19,000 pounds of milk per year would yield less than 1,000 pounds with temperature kept at a constant 95 degrees F. and humidity kept above 60 percent. Providing protection from direct rays of the sun and reducing the humidity below 60 percent restores as much as 5,000



With good feeding and management, a cow can approach top milk production even in hot, humid weather. Graph shows ARS scientists' estimates of the effect of good practices on the production of a cow with a potential of 19,000 pounds of milk per year. (Photo No. PN–1377)



Before development of tent, scientists used cuplike capsules, attached to cow's skin with rubber cement and connected to test tubes containing moisture-absorbing crystals, to measure heat loss through perspiration. (Photo No. PN–1376)

pounds to the cow's production at 95 degrees F. At less severe temperatures, these adjustments also provide relief.

McDowell and Guidry found that cows adjust well to temperatures that rise gradually. They withstand temperatures up to 110 degrees F. at mid-afternoon without a drop in production if these highs are offset with shade and cool nights. Production, the scientists found, seems more closely related to the number of hours per day above 80 degrees F., than to maximum temperature.

In research to date, it has been difficult to measure the extent to which a cow perspires. Scientists previously used a cuplike capsule, glued to the skin with rubber cement, to measure cooling through sweating. Air at a constant moisture level was blown over the skin under the capsule. Test tubes containing moisture-absorbing crystals measured the amount of moisture added to the air by the cow's perspiration.

But the skin of cows differs from place to place in quantity of sweat glands. An Ayrshire cow has up to 2½ times as many sweat glands per square inch along her flank and back as in her legs and neck. To get a representative overall sample, scientists had to cover up to 16 points on a cow's body with capsules.

The new tent largely overcomes these problems. As with the capsule method, the tent is used in the ARS climatological laboratory at Beltsville, where scientists can produce any desired combination of temperature and humidity.

The tent completely encloses a cow except for her head. As air is gently sucked past the cow by a fan in the tent's exhaust system, automatic monitoring devices record the total amount of moisture evaporated from her skin. At the same time, heat loss through the passage of body wastes is recorded.

Heat lost through breathing is measured by a respirometer which fits over the cow's mouth and nose—the same as used previously.

The scientists believe that when rising temperatures cut milk production, the reduction is due more to side effects of hot weather than to direct action of heat upon the cow. Farmers can largely prevent these side effects from bothering cattle by increasing forage quality, and by using drylot feeding to provide shade and cool water and facilities for reducing infections that flourish in hot weather.■

By Slowing Maturity . . .

CHEMICAL PREVENTS PREMATURE APPLE DROP, GROWTH DISORDER

A GROWTH RETARDANT being tested by ARS and the Washington Agricultural Experiment Station looks promising as a means of preventing harvest drop and watercore—two costly problems faced by apple growers.

Use of the retardant, which apparently delays maturity of apples, permits fruit to be harvested before watercore develops and before harvest drop occurs. The resulting longer harvest season could help growers in labor-short areas by enabling them to use fewer workers over a longer period of time.

Watercore is a growth disorder that appears as apples mature on the tree. In normal apples, spaces between the tissues around the core are filled with air, whereas in the diseased fruit, the spaces are filled with water—and mushiness results.

Watercore becomes a serious problem in some areas before apples develop satisfactory harvest color. Although growers suffer little loss if apples are marketed soon after watercore appears, the disorder can cause considerable loss of quality while apples are in storage.

In trials at Wenatchee, Wash., plant physiologist L. P. Batjer and horticulturist M. M. Williams found that the retardant N-dimethyl amino succinamic acid, also called B–995, is effective in preventing both watercore and harvest drop.

B–995 is used widely by commercial nurserymen to control the size of annual and perennial ornamentals. Earlier cooperative trials at Wenatchee showed that the retardant will dwarf and increase the flowering of apple, pear, and sweet cherry trees (AGR. RES., Nov. 1964, p. 3). The chemical, however, has not been approved for commercial use on fruit trees.

Batjer and Williams sprayed B–995 on 20-year-old Delicious and Winesap apple trees at rates of 1,000 or 2,000 parts per million. Sprays were applied early—14 to 20 days after bloom, or late—1 month before the start of normal harvest. Harvest was delayed purposely to accentuate conditions favorable for the development of watercore and harvest drop.

The scientists found the early treatment more effective in reducing watercore and harvest drop than the late treatment; and the lower rate of application slightly more effective in reducing watercore than the higher rate.

Reduction of watercore in treated apples was especially noticeable early in the maturity season. In one experiment, for example, treated fruit had no more watercore at 174 days after full bloom than unsprayed fruit at 160 days. Treated apples had lower soluble solids and greater firmness, indicating that delay in the development of watercore was caused by delayed maturity.

The scientists also found B–995 as effective in reducing harvest drop as the best commercial sprays available for this purpose. And while B–995 slows maturity, some commercial sprays speed up maturity, thus contributing to the development of watercore.

Batjer and Williams plan further testing to determine the best time and rate for applying B–995, the cumulative effect of the retardant on fruit trees, and the effects on storing and eating qualities of the fruit.■

Short roots for asparagus

Farmers and home gardeners may grow asparagus from roots that are short and convenient to handle, as a result of ARS research.

Some growers start asparagus from roots since it takes too long to grow it from seed. Roots may be dug and kept in cold storage so that nurserymen can supply growers' needs during the planting season.

Nurserymen have usually stored asparagus roots untrimmed. In recent tests at Beltsville, Md., horticulturist J. T. Worthington and plant physiologist W. L. Smith, Jr., trimmed roots to 4 and 8 inches in length, then compared them with untrimmed roots for general condition and survival after storage and yield after planting.

Roots trimmed to 8 inches, they found, produced crops with yields as high as those grown from untrimmed roots. Four-inch roots produced crops with yields almost as high. Rate of survival and general condition after storage were as good for trimmed as for untrimmed roots.

Trimmed roots should cost less to store and ship, since it's possible to pack more roots per bag. Trimmed roots are also more attractive after storage than untrimmed roots.

While holding roots in cold storage helps nurserymen fill growers' needs, some suppliers have been unable to keep roots in good condition. Requirements, according to Smith and Worthington, are proper packaging and strict temperature control.

The scientists compared the use of closely woven burlap bags and plastic bags for storage of roots. Roots packaged in burlap and stored at 32 degrees F. with 85 to 95 percent humidity, they found, were in good condition after 2 months.

Roots in plastic bags lost less moisture during storage than those in burlap. Mold, which does not hurt quality but is objectionable in appearance, developed on asparagus in plastic bags after 10 weeks at 32 degrees; and slightly more mold grew after an additional week at 60 degrees. There was no objectionable bud growth on trimmed and untrimmed roots in plastic and burlap bags.

Trimmed asparagus roots take up less space in storage, and are easier to handle, than long, untrimmed roots (Photo No. PN–1378)

Limited market for small hogs

Raising miniature hogs for experimental purposes (AGR. RES., January 1966, p. 6) may eventually become a source of income for some farmers. However, the present market for miniature hogs is extremely limited.

Since AGRICULTURAL RESEARCH reported on the use of the hogs for drug testing by the Food and Drug Administration, ARS swine geneticist J. C. Taylor has received inquiries from farmers who want to get into the miniature hog business.

ARS knows of no commercial source of breeding stock for miniature hogs, Taylor says. And, he adds, practical problems relating to breeding, management, sanitation, and marketing miniature hogs should be worked out before farmers raise them commercially.

ARS also plans to investigate the genetic limits on continued selection for small size. FDA will continue to evaluate the small pigs as laboratory animals.

Increased interest among leaders in medical and biological research may lead to more use of miniature hogs in the future. FDA has permitted (but does not now require) their use for testing any compound used in human medicine. If hogs prove uniquely useful for evaluating specific compounds, their use as test animals might become mandatory for those compounds.

ARS geneticist J. C. Taylor demonstrates the difference in size between a farm-type Yorkshire hog and a typical white miniature pig, both 6-month-old males. The Yorkshire weighed 185 pounds, while the miniature tipped the scales at only 62 pounds. The small hog is a cross between pigs from Hanford Laboratories, General Electric Co., Richland, Wash., a contractor of the U.S. Atomic Energy Commission and from the Hormel Institute of the University of Minnesota at Austin. (Photo No. ST–901–7)

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AGRISEARCH NOTES

Toward red mite control

Recent ARS research answers some of the questions raised by preliminary tests of a technique for controlling citrus red mites—most destructive pests of California citrus orchards—

To rear mites and produce virus, Gilmore and Tashiro allowed mites to remain on lemons for 3 or 4 days—long enough to lay eggs—then transferred mites from infested fruit (above) to uninfested lemons (below). Thus, they used mites repeatedly to start new cultures. (Photo No. PN-1379)

through the use of a virus disease. (AGR. RES., October 1965, p. 14.)

The trials at Riverside, Calif., by Entomologists J. E. Gilmore and Haruo Tashiro, confirm earlier indications that rearing mites, infecting them with the virus, and releasing them to spread disease in natural mite populations is the most promising technique to date for biological control.

Here, in summary, are their results:

● Apparently, reared, inoculated mites do not live long enough after release to cause significant damage to a citrus crop. Neither do they lay enough eggs to significantly increase the population in the succeeding generation.

Mortality of inoculated mites was 100 percent in 12 days. By comparison, 79 percent of the noninoculated (check) mites were still alive after 12 days. Inoculation reduced egg production more than 20-fold.

● Of experimentally reared mites exposed to the virus, 93 percent were infected within 5 days. A 5-day holding period between inoculation and release, used in preliminary tests, appears to be the best holding period.

Indications are that about 40 to 50 percent of the test mites became infected by the initial inoculation, and after 1 to 3 days the mites initially infected were able to transmit infection to the rest of the colony. The few mites not infected at the time of release are subject to the same potential infection as mites in the natural population.

● After release, mites dispersed through fruit trees efficiently enough to carry the disease to native populations. Reared, inoculated mites dispersed as rapidly as reared, uninoculated mites.

The scientists caution that more basic information on performance of the virus in field trials must be acquired before the technique can be considered ready for use on growers' orchards.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

Smugglers try spare tires

An ARS plant quarantine inspector and a Customs official at two different ports of entry recently proved to would-be smugglers that automobile spare tires are bad places in which to hide contraband.

At San Juan, Puerto Rico, a Customs official singled out a man arriving by ship from France for further questioning because of his nervousness and failure to declare all his purchases. He examined the traveler's automobile and found that it took two men to lift the spare tire. Inside the tire he found 40 pounds of meat, prohibited entry by USDA because it may carry livestock diseases such as foot-and-mouth or rinderpest.

At about the same time, an ARS plant quarantine inspector at Eagle Pass, Tex., noted that someone had tampered with the spare tire on an automobile entering from Mexico. The inspector let a little air out of the tire and immediately identified the smell of marijuana. Inside was 6 pounds of marijuana, carefully packed in the tire which had then been reinflated.

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